

AP Chemistry

Intermolecular Forces Worksheet

Name: _____ Date: _____ Period: _____

- Rank the following in order of increasing strength of intermolecular forces in the pure substances, and indicate which ones are most likely to exist as gases at 25°C and 1atm: KI, Ne, CH₄, CO, MgSO₄.
- Tell which member of each of the following pairs of compounds you would expect to have the higher boiling point: (a) O₂ and N₂; (b) SO₂ and CO₂; (c) HF and HI; (d) SiH₄ and GeH₄. In each case, tell what intermolecular forces are involved as well.
- Tell what type of intermolecular force is important in converting each of the following from a gas to a liquid (a) CO₂; (b) NH₃; (c) CHCl₃; (d) CCl₄
- Answer the following questions with "increase," "not change," or "decrease."
 - If the intermolecular forces in a liquid increase the normal boiling point of the liquid will _____.
 - If the intermolecular forces in a liquid increase, the vapor pressure of the liquid will _____.
 - If you increase the surface area of a liquid, the vapor pressure will _____.
- The liquid used in refrigerators and air conditioners is generally one or more of a family of compounds called "Freon". One compound belonging to this group is Freon-11, CCl₃F. If you fill an air conditioner with 1.00kg of the compound, and if the enthalpy of vaporization of CCl₃F is 24.8kJ/mol, how much heat is required to vaporize all of the Freon-11 at its boiling point of 23.8°C?
- Using Figure 13.18 in your textbook, answer the following questions:
 - What is the approximate equilibrium vapor pressure of water at 60°C?
 - At what temperature will water have an equilibrium vapor pressure of 600 mm Hg?
 - Compare the equilibrium vapor pressures of water and ethyl alcohol at 70°C.
 - What is the equilibrium vapor pressure of diethyl ether at room temperature (approximately 20°C)?
- Assume you seal 1.0g of diethyl ether (figure 13.18) in an evacuated 100.-mL flask. (There are no molecules of any other gas or liquid in the flask.) If the flask is held at 30°C, what is the approximate gas pressure in the flask? If the flask is placed in an ice bath, will additional liquid ether evaporate or will some ether vapor condense to a liquid? What is the gas pressure at 0°C?

8. If you place 1.0L of ethyl alcohol in a room that is 3.0 meters side, 2.5 meters deep, and 2.5 meters high, will all of the alcohol evaporate? If some remains, how much will there be? The vapor pressure of ethyl alcohol at 25°C is 59mmHg. The density of ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$) at this temperature is 0.785 g/cm^3 .
9. RbCl crystallizes in the NaCl structure. a) What is the volume of the unit cell? (Rb ion radii = 148pm, Cl ion radii = 181pm) b) What is the density of the solid?
10. LiH crystallizes with H^- ions defining either a simple cubic or a face-centered cubic lattice. The solid has a density of 0.77 g/cm^3 . If the edge of the unit cell is $4.086 \times 10^{-8} \text{ cm}$, how many Li^+ and H^- ions are there in one unit cell? Which unit cell is appropriate for LiH?
11. The molar heat of fusion of water is 6.01 kJ/mol . How much heat energy is required to melt one ice cube in a soft drink (to form liquid water at 0°C if the cube has a mass of 15.0g?
12. Liquid ammonia, $\text{NH}_3(\text{l})$, is still commonly used as a refrigerating liquid and as a heat transfer liquid. The specific heat of the liquid is 4.7 J/gK and that of the vapor is 2.2 J/gK . Its enthalpy of vaporization is 25.1 kJ/mol . If you heat 10. kg of liquid ammonia from -50.0°C to its boiling point of -33.6°C , and then on to 0°C , how much heat energy must you supply?
13. Use the phase diagram for Xenon (p637) to answer the following questions.
 - a) In what phase is xenon found at room temperature and 1.0 atm of pressure?
 - b) If the pressure exerted on the xenon is 0.75atm, and the temperature is -114°C , what phase is xenon in?
 - c) If you measured the vapor pressure of liquid xenon and found 380 mm Hg, what is the temperature of the liquid phase?
 - d) What is the vapor pressure of the solid at -122°C ?
 - e) Which phase is denser, solid or liquid? Briefly explain.
14. Some camping stoves contain liquid butane (C_4H_{10}). They work only when the outside temperature is warm enough to allow the butane to have a reasonable vapor pressure (and so they are not especially good for camping when the temperature is below approximately 0°F). The enthalpy of vaporization of butane is 22.4 kJ/mol .
 - a) Your fuel tank contains 190.g of liquid butane. How many joules of heat energy are required to vaporize all of the butane?
 - b) What is the vapor pressure of butane at 0°F ? (You will need to use the Clausius-Clapeyron equation and data from Table 13.4 for this calculation.) Why doesn't this type of stove work well when the temperature of the air is low?